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**The Difficulty in Measuring the Effectiveness of Airpower at the Operational  
Level of War**

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**A paper submitted to the faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.**

**The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.**

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## Abstract

### THE DIFFICULTY IN MEASURING THE EFFECTIVENESS OF AIRPOWER AT THE OPERATIONAL LEVEL OF WAR

The difficulty in measuring the effectiveness of airpower at the operational level of war has persisted throughout history and carries direct relevance for future operations. The use of airpower during the Second World War in both the Pacific and Europe will illustrate this challenge, while the Berlin Airlift and Six Day War of 1967 will demonstrate how airpower's effects can be effectively measured at the operational level of war. These case studies will show the importance of measures of effectiveness (MOE) and measures of performance (MOP) development for determining successful execution of air operations. It follows that any newly adopted airpower doctrine, effects-based operations (EBO) or otherwise, should first address the question of measurability when it comes to desired effects. With these objective and unbiased MOE, Joint Force Commanders (JFC) will be better prepared to make informed decisions about the appropriate sequencing of current operations. Therefore, rather than adopting new doctrinal guidelines without distinct advantages in assessing operational level effectiveness, future efforts should be directed towards developing criteria to accurately measure the effectiveness of airpower in theater strategic and operational level applications to facilitate a more productive use of airpower's capabilities.

## INTRODUCTION

As the joint community continues to evaluate the wisdom of incorporating an effects-based operations (EBO) concept into doctrine, senior leaders should be cautious about its application. Theorists and strategists must first demonstrate the capability to identify clear measures of effectiveness (MOE) and measures of performance (MOP) for military operations, particularly with regard to airpower. After all, the foundation of EBO lies on the ability to accurately measure effects.<sup>1</sup> It therefore follows that the Joint Force Commander (JFC) must be able to use these measurements to accurately assess the accomplishment of operational and theater strategic level objectives. Although EBO is already recognized in doctrine, the problem of creating MOE for airpower that are capable of objective assessment at the operational level of war still exists today.<sup>2</sup>

Further analysis of some historical cases reveals that when airpower was employed to support or produce operational or theater strategic level results with very subjective MOE, it was difficult to prove that such operations actually produced their desired outcome. The use of airpower in World War II in the European Combined Bomber Offensive (CBO) against Germany and in the Pacific against Japan will illustrate the challenge of isolating the specific effect desired when employing airpower against a wide array of targets in an attempt to influence a nation's leadership. The target sets and supporting operations were simply too vast and subsequently too difficult to link to a specific result.

In contrast, the following cases will demonstrate that it is significantly easier to evaluate the effectiveness of airpower when the MOE are precise and limited, thereby being subject to unbiased and objective evaluation. The Berlin Airlift of 1948-1949 and the Israeli preemptive attack to start the Six Day War in 1967 show how an air operation can attain

theater strategic and operational level success when it is able to concentrate on a particular target set to produce a specific operational or theater strategic effect. In these cases, easily measurable MOE, based on quantitative MOP, enabled the timely assessment of airpower's effectiveness to support the JFC's theater strategic and operational level objectives.

It therefore follows that any newly adopted airpower doctrine, EBO or otherwise, should first address the question of measurability when it comes to desired effects. Regardless of doctrine, any operations plan will be inefficient without a viable measurement. Instead of employing airpower against broad target sets in order to influence an enemy's will or industrial capability, airpower is more effective when focused on a specific requirement or capability that is valued by the enemy and capable of being assessed with objective MOE. Therefore, strict attention should be given to developing additional criteria to assist in measuring the effectiveness of airpower in theater strategic and operational level applications, so as to allow the JFC to make timely adjustments to operations in order to achieve optimal results.

### **AIRPOWER MEASUREMENT CONSIDERATIONS**

To begin an exploration of the problems inherent in measuring airpower's effectiveness at the operational level, it is imperative to understand a few terms essential to this investigation. To begin, one must fully understand "effects" and assessment tools, such as, MOE and MOP. The Joint Warfighting Center (JWC) defines effects as "the physical and/or behavioral state of a political, military, economic, social, infrastructure, and information system that results from a military or nonmilitary action or set of actions."<sup>3</sup> The USAF similarly defines it as "a full range of outcomes, events, or consequences that result from a specific action."<sup>4</sup> For the purposes here, both definitions are applicable. Although the

USAF definition allows for tactical level effects, this study will only address theater strategic and operational level effects.

In order to decide if an operation has produced a specific effect, an assessment must be accomplished. This measurement can be completed by assessing two elements, MOP and MOE. MOP verify that a given task was accomplished, while MOE determine if the desired effect was attained. These two elements are then used to support the overall effects-based assessment (EBA) that will influence the JFC's decision process.<sup>5</sup>

Finally, it is important to recognize that the joint EBO concept is still being refined. The JWC's *Doctrine Pamphlet 7 (DP)* is the current leading document on EBO, but JWC has created a new publication titled *The Commander's Handbook for an Effects-Based Approach to Joint Operations*. This new handbook is still in draft form and has already passed its expected publishing date of January 2006.<sup>6</sup>

### **THE COMBINED BOMBER OFFENSIVE IN EUROPE**

In this analysis, the air operations will be considered in their entirety and not as individual air battles or bombing missions. The overall directive for the CBO, Operation POINTBLANK, was approved by the Combined Chiefs of Staff in May 1943 and originated from the Casablanca Conference of January 1943, when the allied leaders established the strategic objectives for Europe.<sup>7</sup> The air strategy evolved from previously drafted U.S. and British airpower theories. In support of this doctrine, the mission for the CBO was to conduct offensive air operations against Germany in an attempt to affect its morale and generate its defeat by dislocating its industrial, economic, and military capabilities.<sup>8</sup>

Although the British and U.S. objectives were the same, the two nations held different opinions as to the best tactics to employ. The U.S. wanted to use daylight precision

bombing, while the British wanted to conduct night time area bombings. The two different tactics were employed simultaneously in seeking to produce the same effect, which further compounded the problem of assessing the final outcome. The greatest difficulty in measurement however was created by the broad range of targets that were selected for attack. The nations agreed on the combined plan to strike 76 specific targets that were part of six separate systems, including the submarine bases and construction facilities, aircraft industry, ball bearings, oil, synthetic rubber and tires, and military transport vehicles.<sup>9</sup> Unfortunately, they did not truly have the capability to accomplish this plan. Using MOP to establish accuracy rates of the bombers, it was determined that 2,702 bombers were required to accomplish the stated mission of the CBO.<sup>10</sup> Based on the strategists own MOP, the CBO was unlikely to be successful since “the heavy bomber force envisioned by the plan fell somewhat short of its goal...only 852 actually had been assigned to the VIII Bomber Command.”<sup>11</sup>

In the end, the effectiveness of the CBO and the overall air operations were inconclusive at best.<sup>12</sup> Using one of the target areas as an example helps clarify why. The aircraft industry target had an established MOP with the goal to destroy 43% of fighter and 65% of bomber production in order to prevent the Germans from resisting the allied air and ground forces.<sup>13</sup> On the surface, these measures seem understandable if not attainable, but in reality they were very difficult to gauge. In fact, accurate assessments of this MOP were only achievable after the war when the records could be analyzed.<sup>14</sup>

These results indicated that the Germans were quite effective at maintaining aircraft production rates while being bombed. Surprisingly, production increased steadily throughout the CBO. Single-engine fighter production reached a wartime peak in September of 1944

and in this year alone 25,860 ME-109s and FW-190s were produced while under almost constant aerial bombardment.<sup>15</sup> Had airpower been able to direct its efforts toward this single target set, perhaps the effect would have been more distinct. Instead, by spreading limited bomber resources against a broad target set, decisive effects in any of the six identified target areas were not readily available to the commander and only finally documented in a 208 volume post-war survey.<sup>16</sup>

Many different conclusions have been voiced about the effectiveness of the CBO, but as one historian, Richard Overy, states, “allied air power had finally achieved air supremacy by the end of the war, but there was considerable confusion at the time as to why it had been so successful and even less agreement about the contribution of air power to the overall victory.”<sup>17</sup> Given the complexity of the CBO, it is quite obvious that even though there was considerable attention devoted to airpower’s use, an assessment of the actual effects could not ultimately prove that airpower attained the desired result.

Historically, by not focusing on a particular effect that can be precisely measured, strategists are tempted to employ airpower in such a general fashion that the JFC is unable to isolate particular missions that may have been decisive. In this case, the overall theater strategic objective to defeat Germany was accomplished. However, there were no MOE or MOP that could precisely link the CBO to having been instrumental in producing a decisive operational level effect, either in the realm of influencing Germany’s morale, or in something more systematic, such as impeding their aircraft production capability.

### **AIRPOWER IN THE PACIFIC**

Much like the European Theater, the Pacific Campaign will demonstrate the difficulty and complexity of assessing airpower MOE and associated effects at the operational level of



war. This case is another example that shows how strategists developed subjective MOE to evaluate airpower effects that were inherently difficult to measure accurately in the context of an enormous military operation. Of course, the Japanese finally surrendered after the U.S. Army Air Force dropped two atomic bombs, but was it the tremendous destructive power of these bombings that caused the surrender?<sup>18</sup> What about the fire-bombing of four Japanese cities 5 months earlier that destroyed 31 square miles of those cities, the gradual invasion through the outer islands, the disruption of sea lines of communication by naval forces, or the Russian declaration of war?<sup>19</sup>

The U.S. plan for the Pacific theater altered dramatically after the Japanese attack on Pearl Harbor. The initial plan had been to maintain a defensive position, but the surprise attack changed everything. It was quickly realized that air superiority could provide the conditions to enhance operations in the Pacific as the U.S. transitioned to an offensive posture. It was also recognized that due to range limitations at the time, forward operating bases needed to be established close enough for the bombers to reach Japan in order to continue offensive plans. In addition to supporting the bombing attacks, these bases would also create a strategic advantage by providing staging locations to interdict Japanese shipping and to prepare to mount the ground invasion of Japan.<sup>20</sup>

The acquisition of these forward operating bases required extensive joint operations to position land-based aviation closer to the Japanese mainland. The magnitude of these operations lends further evidence to the notion that bombing alone did not induce the surrender. Without naval contributions, such as, the battles at Coral Sea, Midway, and Guadalcanal, or the submarine's destruction of 10% of the merchant shipping in the first year of the war, the Japanese war machine would have been much stronger.<sup>21</sup> Likewise, these

famous battles continued on the ground as the Army and Marines started their approach to Japan through the outer islands.<sup>22</sup> Throughout this time, the damage to Japan's military forces and economy was staggering. By July 1945, Japan did not have sufficient oil or fuel oil to operate its naval forces and the aviation arm had been virtually reduced to a kamikaze force. U.S. naval and land-based aviation were a contributing factor in the successes of the Pacific campaign, but the evidence supports a more balanced viewpoint that this was a complex campaign which involved each of the armed services in such an interdependent way that it is nearly impossible to ascribe the surrender to just airpower alone.<sup>23</sup>

In addition, the initial MOE set for the air attacks against the Japanese homeland were broad-based and difficult to assess. In November 1944, airpower's objective was to conduct offensive bombing operations as a supporting force in order to shape the battle space of the Japanese home islands in preparation of a ground force invasion.<sup>24</sup> A specific MOE was established for air operations that based success on "the extent to which it would weaken enemy capability and will to resist our amphibious forces at the time of landings."<sup>25</sup> This MOE was inherently flawed. First, the very language of the MOE did not allow for an accurate assessment to occur prior to the invasion. Secondly, this MOE did not specify quantitative MOP to measure whether or not the enemy's capabilities were in fact weakened by the completion of a particular task or mission. Although air operations undoubtedly contributed to the weakening of Japan, this MOE was not uniquely suited to match airpower's strengths. As shown, success depended on a combined joint operation. In the end, this example illustrates the intrinsic problems of using broad-based MOE that must be assessed subjectively, making it difficult for the commander to measure airpower's distinct effects at the operational level of war.

Of course, the obvious counterargument is that airpower ultimately delivered the desired effect. An amphibious invasion was never required, because the Japanese did surrender after the U.S. dropped the two atomic bombs.<sup>26</sup> The trouble with this counterargument is that there is a lack of evidence to link the actions, bombing operations, to the desired effect, the final surrender. The U.S. Strategic Bombing Survey acknowledges that

Based on a detailed investigation of all the facts supported by the testimony of the surviving Japanese leaders involved, it is the Survey's opinion that certainly prior to 31 December 1945, and in all probability prior to 1 November 1945, Japan would have surrendered even if the atomic bombs had not been dropped, even if Russia had not entered the war, and even if no invasion had been planned or contemplated.<sup>27</sup>

Further study of the Japanese leadership reveals that in 1944 a group of them had already begun discussion on how to end the war. During May 1945, months before the atomic bombs, the question of surrender was actively being considered.<sup>28</sup> Thus, given the extensive nature of the operations prior to the direct attacks on Japan and the subjective MOE, a direct link between airpower and victory cannot be conclusively demonstrated. The lesson to future strategists is that by employing airpower in instances where the desired effect is too broad and its attainment is based on subjective MOE, then the true effects become masked by an inability to distinguish its accomplishments from other operations. This ambiguity is obviously of little use to a JFC that wants to use air assets in the most efficient way.

### **THE BERLIN AIRLIFT**

Although European and Pacific bombing operations had flawed MOE, there are other cases to the contrary that depict airpower's capacity to be definitively measured by using clear MOE and MOP. The Berlin Airlift is one such case that will illustrate the ability of

airpower to be employed in a non-violent, constructive way to achieve a very specific theater strategic level objective. In this example, airpower employment also displays the important quality of being measurable, while it is still possible to make midcourse adjustments in order to influence the eventual outcome.

The airlift began after the Soviets restricted ground access to Berlin on 24 June 1948. After diplomatic disagreements on currency reform in Germany, the Soviets stopped train and automobile transportation to Berlin by prohibiting use of the previously established highway and railroad routes. Entrance to the allied zones of occupied Berlin was limited to aircraft using established air corridors that traversed the Soviet controlled sector in East Germany. This ground blockade isolated more than two million civilians in West Berlin and limited their ability to get supplies.<sup>29</sup>

The U.S. Military Governor, General Lucius Clay, was the equivalent of a modern day JFC or Regional Combatant Commander responsible for the U.S. area of responsibility in Germany. He recognized the situation as a ground blockade and began to evaluate his options. He initially wanted to use an armored column to break the blockade, but the Joint Chiefs of Staff forbade the use of force, fearing the instigation of World War III. Given this restraint, General Clay knew airlift was the only viable option to produce the desired effect, which was to negate the blockade without force.<sup>30</sup> The responsibility of producing this effect was soon passed to a newly created Airlift Task Force under the command of Major General William H. Tunner. His tremendous airlift experience from World War II made him the ideal leader for this operation.<sup>31</sup> Under his leadership, the tactical level execution of the mission was extraordinary and illustrated the ability for airpower to support theater strategic objectives of a JFC.<sup>32</sup>

General Tunner believed that the Soviets had miscalculated the capability of the U.S. and Britain to accomplish the mission based on their experience in Stalingrad.<sup>33</sup> The amazing results of the operation displayed on Easter Sunday in April of 1949 changed the Soviet's mind. The airlift operations delivered nearly 13,000 tons on 1,398 flights, managing to deliver the equivalent of 12 fifty-car coal trains in a day. From then on, General Tunner's task force never delivered less than 9,000 tons per day. The Soviets realized the blockade was pointless and ended it one month later on May 21, 1949.<sup>34</sup>

Aside from completing an astounding task, airpower directly supported the theater level objective established by General Clay. The operation plainly illustrated the successes that can be achieved when airpower is employed in a manner that is accurately measurable against established criteria in order to produce a desired and quantifiable theater strategic level effect. The effects were easily quantifiable using MOP based on the city's minimum daily supply requirement of four-thousand tons.<sup>35</sup> Once the required supplies for Berlin had been established, airlift planners provided adequate aircraft to accomplish the mission and assess progress using unbiased and quantifiable MOP.

Based on the allocated aircraft and load capacity, General Clay originally estimated that airlift could only deliver between 600 and 700 tons per day, well short of the city's needs. Even though, initial plans were created to use 65% of available aircraft and to use each aircraft for three round trips, minimum requirements were not met. General Tunner then reasoned that an airport could support the landing of an aircraft every 3 minutes with departures in between. Given this estimate and the number of minutes in a day, he planned to have 480 landings and 480 departures each day per airport.<sup>36</sup> This recalculation and adjustment to the operation, based on the MOP, enabled the task force to meet and surpass

the city's needs. It was soon evident that airpower could supply the city indefinitely.<sup>37</sup> The blockade was useless for cutting off the city.

Once the MOP were assessed, the MOE could also be evaluated. "When the sufficiency and sustainability of the airlift became apparent, it was checkmate. Thereafter, if the blockade was to be continued, the West could only gain international admiration at the expense of the Soviets."<sup>38</sup> Time was clearly on the side of the West. The MOE could be continually measured objectively and adjusted for the desired effect. Either the Soviets removed the blockade or not. In the end, the airlift delivered the desired effect. Ground troops were not required, World War III was averted, and the blockade was lifted on May 21, 1949.<sup>39</sup>

In addition to being measurable, this operation was uniquely suited for near immediate assessment. It simply became a question of unbiased mathematics. The commander knew the capacity of his aircraft and the flying schedule. Once operations were running smoothly, it was a matter of keeping operations on schedule. This situation allowed the commander to assess the established MOP and MOE and to make real-time adjustments to the operational design of his plan as necessary to support the theater strategic level objective. In the end, airpower had successfully produced a theater strategic level effect by being employed to support a highly specific and measurable mission; the supply of a city with airlift.

### **THE ISRAELI SIX DAY WAR OF 1967**

As with the Berlin example, the Six Day War of 1967 was an astoundingly successful operation by an air force, but this time using the destructive capability of airpower. This example will demonstrate how airpower can be used successfully in order to satisfy an

operational level requirement, while providing the leadership the capability to conduct timely assessments to verify accomplishment of the mission. Furthermore, analysis shows that the ultimate Israeli victory can be directly attributed to the Israeli Air Force (IAF) focusing on a specific objective, destruction of the Egyptian Air Force. The IAF's successful accomplishment of the objective led to the production of a measurable operational level desired effect.

To begin, it is important to understand the operational level objective of the Israelis. Israel's neighbors, Egypt and Syria, had positioned troops on the Israeli borders in the Sinai and Syria. Egypt had also closed the Straits of Tiran and expelled United Nation peacekeepers from the Sinai.<sup>40</sup> As a result, the Israelis were threatened and fearing an attack, decided to preemptively attack Egypt with immediate follow-on attacks on Syria, Jordan, and Iraq. The primary operational level objective was to destroy the Egyptian Air Force, specifically their fighter and bomber aircraft, in order to prevent an Egyptian led Arab attack against Israel and its forces.<sup>41</sup>

In order to accomplish this objective, the IAF established a detailed attack and assessment plan. The Israeli intelligence effort was focused on air operations and supported IAF targeting plans. During the initial attacks, sixteen aircraft were assigned to each target. Flexibility was built into the plan to allow for the attacking of secondary targets in the event the assigned target was destroyed. Additionally, each pilot was specifically trained to conduct battle damage assessment in a particular target area. These tactical level assessments enabled the commander to make rapid operational level decisions about follow-on operations.<sup>42</sup>

The results were staggering. The assessment tactics were so effective that during the first day's strikes on June 5, 1967, the IAF conservatively estimated 387 enemy aircraft were destroyed. Subsequent analysis by the IAF Commander estimated the number to be nearly 410 aircraft.<sup>43</sup> After 6 days of war, the final tally in open sources stated that 452 enemy aircraft were destroyed, effectively diminishing "Arab air force capabilities to the level of sporadic harassments."<sup>44</sup>

The IAF's assessment showed that it had control of the air, which provided an environment to successfully attack the remaining enemy forces. Without air cover, the Egyptian army lost 80% of its equipment and the Sinai was entirely under Israeli control within the first 4 days of the war.<sup>45</sup> The completion of the air operational level objective provided Israeli ground forces freedom of maneuver to repel the enemy forces on the ground and become an offensive force instead of a defensive one.<sup>46</sup> By the end of the war, Israel had gained control of the Sinai Peninsula, the Gaza Strip, the Golan Heights, and the West Bank of the Jordan River.<sup>47</sup> By directing airpower against a specific target set, in this case the enemy air force, the MOE could be objectively assessed to validate the accomplishment of the desired effect and allowed the commander to allocate combat forces towards other operations.

## **RECOMMENDATION AND CONCLUSION**

The preceding historical examples illustrated the importance of measurement in definitively assessing the effectiveness of airpower in supporting a JFC's objectives at the operational level of war. The Pacific and European examples demonstrated the challenges inherent in using airpower along with other forces to produce broad effects against a theater strategic level objective, such as, an enemy's will or an entire industrial and military



capability. The similarity in these two examples was the inability to connect the actions conducted by airpower to the eventual outcome. Was the CBO effective in achieving air superiority even though it did not decisively destroy Germany's aircraft production capability? Did bombing Japan with incendiary or atomic weapons cause the surrender? What about the role of naval and army operations? The ultimate victories in either theater are not the point. Instead, it is important to be able to measure what action created these final outcomes. In these instances, it was difficult to isolate the proof that airpower had produced the desired outcome, even though, in each case, the enemy eventually capitulated. In contrast, the Berlin Airlift and Six Day War demonstrated instances where airpower was successfully applied to produce theater strategic and operational level effects by employing it in a very specific and measurable manner. It therefore follows that airpower is more effective when focused on a specific requirement or capability that is valued by the enemy and capable of being assessed with objective measurements.

Therefore, renewed energy should be devoted to developing criteria to accurately measure the effectiveness of airpower in theater strategic and operational level applications. An understanding of such criteria would facilitate a better measurement of airpower and allow the JFC to make real-time adjustments to operations as necessary. These criteria are necessary to establish a link between the action taken and the ultimate effect. In order to accurately measure the operational level of the effectiveness of airpower, these criteria must be objective and unbiased. Coupled to these characteristics is the need to have the mission play to the unique strengths that airpower offers a commander. For example, the Berlin Airlift clearly illustrated a scenario in which only airpower could provide the desired effect. Geographically, naval forces were out of the question and ground forces would have

provoked a hostile response from the Soviets. The Six Day War also met the same criteria. It is unlikely that Israeli land forces could conduct the surprise attack, deep inside enemy territory, that was necessary to neutralize the enemy air forces that were poised to attack from four nations. In both cases, not only was airpower uniquely suited to both the mission and the selected MOE, but given the circumstances, it was clearly possible to conduct an unbiased and objective evaluation of the desired effect.

Although it may seem obvious that objective measurement is superior to subjective measurement, past and present airpower employment has demonstrated a lack of attention in using airpower towards measuring effects with objective MOE. Furthermore, strategists should be cautious about the use of subjective MOE that could potentially be used for other agendas. For example, the U.S. Strategic Bombing Surveys of World War II are still criticized as having been a political instrument created to advocate the establishment of an independent air force.<sup>48</sup> Whether true or not, it is less likely that objective measurements can be manipulated to support underlying agendas. Therefore, joint airpower planners should acknowledge these past difficulties to prevent similar problems in current and future operations.

Unfortunately, the U.S. Air Force still has work to do as to avoid subjective MOE in current operations. For example, on January 5, 2006, the Combined Forces Air Component Commander (CFACC) published a summary of airpower's success for 2005 in the Middle East. It states that the 2005 elections in Iraq and Afghanistan "couldn't have happened without air power. CFACC aircraft deterred ground attacks during both elections and post-election activity."<sup>49</sup> Initial decisive combat phase operations aside, it is difficult to support the notion suggested here that airpower's efforts can be directly credited with enabling

elections. Is it possible that the elections would not have continued without airpower's presence?

As in the World War II examples, there is no explicit link between the actions, air operations, and the intended outcome, elections. In essence, airpower does not appear to be able to exclusively produce the desired effect, nor is its ability in this regard, truly measurable. What these case studies do illustrate is that airpower works best when employed against distinct target sets that will have a precise impact on the enemy's capabilities and intent. This is not to imply that airpower targeting alone can win a war or that its use should be somehow limited. Instead, this recommendation simply advocates measuring airpower's effects with MOE that are clearly measurable and objective. Unless airpower is used to support missions that are uniquely matched to its strengths, the results might be inconclusive and attribute airpower with an unwarranted failure.

Lastly, the problem of measuring the effectiveness of airpower at the operational level of war has doctrinal implications for future warfighters. The joint community is on the brink of adopting an EBO concept and the USAF has already included EBO in its doctrinal publications.<sup>50</sup> Senior leaders should ensure that any new joint EBO doctrine has been fully vetted for measurement issues before publishing and endorsing new guidelines for joint employment. Instead, future operational level doctrine development should concentrate on refining its guidelines to commanders in improving their ability to accurately measure the effectiveness of joint operations at the operational level of war.

U.S. Joint Forces Command has already introduced EBO to the services with its *DP* 7. Unfortunately, *DP* 7 does not adequately address the challenges associated with measuring effects at the operational level of war. Although it does explain that EBA is a

major component of EBO, its limited discussion of EBA does not resolve the potential difficulty inherent in various operational situations. It defines EBA tools, MOE and MOP, and how to conduct effects-based planning, but it does not provide direction on how best to identify actions and effects in broad terms.<sup>51</sup>

In conclusion, although the measurement of airpower's ability to produce desired effects has been difficult at the operational level of war under certain past circumstances, these examples carry direct relevance for future operations. By using airpower to achieve specific effects that have clear, objective, and unbiased MOE, it can be more reliable, as shown during the Berlin Airlift and the Six Day War. With these effective MOE, JFCs will be better prepared to make informed decisions about the appropriate sequencing of current operations. Therefore, rather than adopting new doctrinal guidelines without distinct advantages in assessing operational level effectiveness, future efforts should be directed towards developing criteria to accurately measure the effectiveness of airpower in theater strategic and operational level applications to facilitate more effective use of airpower's capabilities.

## NOTES

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<sup>1</sup> United States (U.S.) Joint Forces Command, Operational Implications of Effects-based Operations (EBO), Doctrine Pamphlet (DP) 7 (n.p., Joint Warfighting Center, 17 November 2004), 16-17.

<sup>2</sup> U.S. Air Force (USAF), Air Force Basic Doctrine, Air Force Doctrine Document (AFDD) 1 (Maxwell Air Force Base, AL: Air Force Doctrine Center, 17 November 2003), 38. The USAF has already formally recognized EBO in its doctrine. Although the USAF has four criteria that each of its 17 operational functions support, none of the criteria address the challenges associated with measurement of these functions.

<sup>3</sup> U.S. Joint Forces Command, DP 7, 2.

<sup>4</sup> USAF, 98.

<sup>5</sup> U.S. Joint Forces Command, DP 7, 16-17.

<sup>6</sup> \_\_\_\_\_, The Commander's Handbook for an Effects-Based Approach to Joint Operations (DRAFT), (n.p., Joint Warfighting Center, 16 January 2006).

<sup>7</sup> R. J. Overy, The Air War 1939-1945 (New York: Stein and Day, 1980), 86; Charles Webster and Noble Frankland, "The Combined Bomber Offensive from the United Kingdom (POINTBLANK) as Approved by the Combined Chiefs of Staff, 14<sup>th</sup> May 1943," The Strategic Air Offensive Against Germany, Volume 4 (London, Her Majesty's Stationary Office, 1961), 273-274.

<sup>8</sup> B. L. Blustone and J. P. Peak, Air Superiority and Airfield Attack (Washington D.C.: Defense Nuclear Agency, 15 May 1984), 88; Overy, 73; Stephen A. Parker. "AWPD-1 Targeting for Victory: The Rationale Behind Strategic Bombing Objectives in America's First Air War Plan," Airpower Journal. Summer 1989. <<http://www.airpower.maxwell.af.mil/airchronicles/apj/apj89/parker.html>> [29 January 2006]; Webster and Frankland, 273-274. The development of Air War Plans Division (AWPD) Plan 1 and AWPD-42 had an additional objective as well. At this point in time, the U.S. Army Air Force was still pursuing the creation of an independent service for the aviation arm of the U.S. Army. Therefore, to some extent at least, these initial AWPD documents were created to further this proposal and to advocate the strategic ability of airpower to be a decisive force without the use of other military forces.

<sup>9</sup> Webster and Frankland, 273-274.

<sup>10</sup> Thomas Allen Fabyanic, A Critique of United States Air War Planning 1941-1944 (Ann Arbor, MI, University Microfilms International, 1985), 175.

<sup>11</sup> Ibid, 180.

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<sup>12</sup> Blustone and Peak, 86.

<sup>13</sup> Webster and Frankland, 274. Specific MOP were established for each of the target sets and were clearly stated in this document, only one example is used here for illustrative purposes.

<sup>14</sup> The European War U.S. Strategic Bombing Survey (USSBS), (Washington D.C., U.S. GPO, 1946). The post-war USSBS was chartered to assess the European air operations in a massive 208 volume collection, the sheer number of which serves as a perfect example of the complexity of the problem of measuring the effectiveness of airpower at the operational level of war.

<sup>15</sup> \_\_\_\_\_, Aircraft Division Industry Report, Volume 4 (Washington D.C., U.S. GPO, 1946), Figure VI-1.

<sup>16</sup> Ibid, Volume 1, (Washington D.C., U.S. GPO, 1946).

<sup>17</sup> Overy, 82.

<sup>18</sup> The Pacific War USSBS, The Effects of Atomic Bombs on Hiroshima and Nagasaki, Volume 2 (Washington D.C., U.S. GPO, 1946), 23.

<sup>19</sup> \_\_\_\_\_, Summary Report (Pacific War), Volume 1 (Washington D.C., U.S. GPO, 1946), 16.

<sup>20</sup> Ibid, 4-6.

<sup>21</sup> Ibid, 6-8. Aircraft were only credited with destroying four percent of the merchant ships during the first year of the war.

<sup>22</sup> “World War II in the Pacific: Menu to the early years.”  
<<http://www.ww2.pacific.com/ww2.html>> [29 January 2006]

<sup>23</sup> Overy, 100; The Pacific War USSBS, Volume 1, 10-11.

<sup>24</sup> The Pacific War USSBS, Volume 1, 15.

<sup>25</sup> Ibid, 16.

<sup>26</sup> Ibid, 26.

<sup>27</sup> Ibid.

<sup>28</sup> The Pacific War USSBS, Volume 2, 22.

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<sup>29</sup> William H. Tunner, Over the Hump (Washington D.C., Office of Air Force History 1985), 157-158.

<sup>30</sup> Tunner, 157.

<sup>31</sup> Roger D. Launius, "The Berlin Airlift: Constructive Air Power," Air Power History (Spring 1989): 10-12; Tunner, x. Major General Tunner was renowned for his contribution to getting over the "Hump." The "Hump" was the name for the treacherous supply air route that connected northeastern India to southwestern China in the Pacific theater during World War II.

<sup>32</sup> Lanis, 19. In total 2,325,509.6 tons had been delivered to Berlin on 277,569 flights from 26 June 1948 until 30 September 1949.

<sup>33</sup> Tunner, 184. The German's failed to save 290,000 troops in Stalingrad using airlift during World War II, so the Soviets reasoned that over two million people would be impossible to support.

<sup>34</sup> Ibid, 222.

<sup>35</sup> Ibid, 159.

<sup>36</sup> Ibid, 174.

<sup>37</sup> Launius, 10-11.

<sup>38</sup> Carl H. Builder, "Keeping the Strategic Flame," Joint Forces Quarterly (Winter 1996-1997): 79.

<sup>39</sup> Ibid, 18.

<sup>40</sup> "Arab-Israeli Conflict, War of 1967," Wikipedia: The Free Encyclopedia. <[http://en.wikipedia.org/wiki/Arab-Israeli\\_War#War\\_of\\_1967](http://en.wikipedia.org/wiki/Arab-Israeli_War#War_of_1967)> [4 February 2006]

<sup>41</sup> Blustone and Peak, 144.

<sup>42</sup> Ibid, 143.

<sup>43</sup> Ibid, 137. Initial estimates reported 300 Egyptian, 52 Syrian, 20 Jordanian, and 15 Iraqi aircraft destroyed during the first strikes.

<sup>44</sup> Ibid, 139.

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<sup>45</sup> George W. Gawrych, "The Egyptian Military Defeat of 1967," Journal of Contemporary History, Volume 26, No. 2 (April 1991): 300.

<sup>46</sup> Ibid, 290-291.

<sup>47</sup> "Six Day War, Conclusion of Conflict and Post-War Situation," Wikipedia: The Free Encyclopedia. <[http://en.wikipedia.org/wiki/Six-Day\\_War#Conclusion of conflict and post-war situation](http://en.wikipedia.org/wiki/Six-Day_War#Conclusion_of_conflict_and_post-war_situation)> [29 January 2006].

<sup>48</sup> Stewart Halsey Ross, Strategic Bombing by the United States in World War II: The Myths and Facts (Jefferson, NC: McFarland and Co., Inc., 2003), 197.

<sup>49</sup> Alicia Prakash, "CFACC Air Power flies through 2005 successes," USAF AIM Points, January 5, 2006, 5 January 2006, <<https://aimpoints.hq.af.mil/archives.cfm>> [5 January 2006].

<sup>50</sup> USAF, 98.

<sup>51</sup> U.S. Joint Forces Command, DP 7, 16-17.



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